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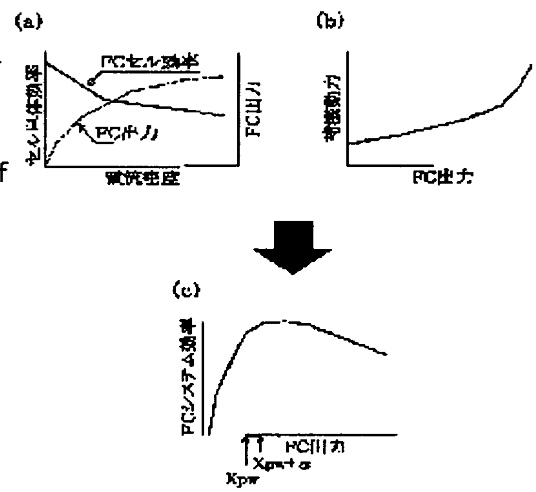
(54) FUEL CELL SYSTEM AND ELECTRIC VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce futility in power generation of a fuel cell, and to improve efficiency as the whole system having the fuel cell and a secondary battery.

SOLUTION: The fuel cell system 10 determined run and stop of a fuel cell apparatus group including the battery 20 and its peripheral units depending on magnitude of driving power for a vehicle demanded by the operator through stepping operation of an accelerator. When this demanded driving power is obtained by generating operation of the fuel cell in a low load region below a threshold power Xps, the fuel cell equipment group is let stop and a motor 32 is rotated by a secondary battery 30 alone with its remaining capacity, to drive the vehicle with the demanded driving power.



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CLAIMS

[Claim(s)]
[Claim 1] It is the fuel cell system equipped with the means for stopping which it is the fuel cell system which has the fuel cell and the rechargeable battery which were connected to juxtaposition, and the electric power supply means which supplies power from said both cells to said load to a load, said electric power supply means suspends the generating mode of said fuel cell when a detection load is a predetermined low-loading field, a detection means detect the magnitude of the load connected, and, and stops the electric power supply from said fuel cell.
[Claim 2] It is the fuel cell system which has a means to be a fuel cell system according to claim 1, and to suspend operation of the fuel cell auxiliary machinery with which said means for stopping participates in said generating mode.
[Claim 3] It is the fuel cell system which has a means to forbid actuation of said means for stopping when it is a fuel cell system according to claim 1 or 2 and said electric power supply means can provide said detection load in the case of said low loading field with a means to detect the remaining capacity of said rechargeable battery, and said detection remaining capacity.
[Claim 4] claim 1 thru/or a claim -- the fuel cell system by which it is the fuel cell system of a publication 3 either, and said low loading field is made into about 10% or less of field of the power serviceability of said fuel cell.
[Claim 5] It is the fuel cell system by which it is a fuel cell system according to claim 1, and said load connected consists of the 1st load which is the electric power supply point to the outside of a fuel cell system, and the 2nd load which is the electric power supply point into a fuel cell system.
[Claim 6] It is the fuel cell system equipped with the means for stopping which it is the fuel cell system which has the fuel cell and rechargeable battery which were connected to juxtaposition, and the electric power supply means which supplies power from said both cells to said load to a load, said electric power supply means suspends the generating mode of said fuel cell when the system efficiency of a fuel cell system is below a predetermined value, and stops the electric power supply from said fuel cell.
[Claim 7] The fuel cell and rechargeable battery which are the electric vehicle which obtains driving force by rotating a motor and telling the turning effort of this motor to an axle with electrical energy, and were connected to juxtaposition, The fuel cell system which has the electric power supply means which supplies power from said both cells to said load to a load is carried. Said electric power supply means of said fuel cell system A detection means to detect the magnitude of the load connected, and when a detection load is a predetermined low loading field It is the electric vehicle with which it has the means for stopping which suspends the generating mode of said fuel cell and stops the electric power supply from said fuel cell, and said motor receives supply of power from said fuel cell system.
[Claim 8] It is the electric vehicle with which it is an electric vehicle according to claim 7, and said load connected consists of the 1st load which is the electric power supply point to the outside of a fuel cell system, and the 2nd load which is the electric power supply point into a fuel cell system.
[Claim 9] The fuel cell and rechargeable battery which are the electric vehicle which obtains driving force by rotating a motor and telling the turning effort of this motor to an axle with electrical energy, and were connected to juxtaposition, The fuel cell system which has the electric power supply means which supplies power from said both cells to said load to a load is carried. Said electric power supply means of said fuel cell system It is the electric vehicle with which it has the means for stopping which suspends the generating mode of said fuel cell and stops the electric power supply from said fuel cell when the system efficiency of a fuel cell system is below a predetermined value, and said motor receives supply of power from said fuel cell system.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electric vehicle carrying the fuel cell system equipped with the fuel cell and the rechargeable battery, and this fuel cell system in detail about a fuel cell system and an electric vehicle.
[0002]
[Description of the Prior Art] Conventionally, as this kind of a fuel cell system, it has a fuel cell and a rechargeable battery as a power source, and what supplies power to loads, such as a motor, from both this cell is proposed (for example, JP,7-240212,A etc.). As this fuel cell system operates a fuel cell in the range where the conversion efficiency of that fuel to be used is high rather than controls the output of a fuel cell simply according to the change in a load, he is trying to maintain the conversion efficiency of a system in the high range.
[0003]
[Problem(s) to be Solved by the Invention] By the above-mentioned conventional fuel cell system, it will be operated with a fuel cell irrespective of the size of the power by which supply is needed for a load with high conversion efficiency. Therefore, even when a load was small, since a fuel cell would continue operation in the high conversion efficiency range, the generation of electrical energy of a fuel cell might become useless.

[0004] This invention is made in order to solve the above-mentioned trouble, it reduces the futility of a generation of electrical energy with a fuel cell, and aims at aiming at improvement in effectiveness as the whole system which has a fuel cell and a rechargeable battery.
[0005]
[The means for solving a technical problem, and its operation and effectiveness] In order to solve a part of this technical problem [at least], the fuel cell system of this invention It is the fuel cell system which has the fuel cell and rechargeable battery which were connected to juxtaposition, and the electric power supply means which supplies power from said both cells to said load to a load. Said electric power supply means Let it be the summary to have a detection means to detect the magnitude of the load connected, and the means for stopping which suspends the generating mode of said fuel cell and stops the electric power supply from said fuel cell when a detection load is a predetermined low loading field.
[0006] In the fuel cell system of this invention which has the above-mentioned configuration, when the magnitude of a load is a predetermined low loading field, the generating mode of a fuel cell is suspended and the electric power supply from the fuel cell is stopped. And power is supplied to a load from a rechargeable battery by the power control means in this case. For this reason, in a low loading field, since the generating mode of a fuel cell is not required, the effectiveness as the whole system can be improved so that a generation of electrical energy of a fuel cell may not become useless. As this low loading field, it can consider as about 10% or less of field of the power serviceability of a fuel cell.
[0007] Moreover, the 2nd load (namely, load within a fuel cell system) which participates in maintenance of not only the 1st load in the case of supplying the generated output obtained with the fuel cell out of a fuel cell system but a fuel cell system is contained in the above-mentioned load. And supposing the magnitude of the 2nd load is the above-mentioned low loading field, system maintenance will be aimed at by the electric power supply from a rechargeable battery.
[0008] In this case, like the case where it is based on the magnitude of the load connected, the generating mode of a fuel cell is suspended as the system efficiency of a fuel cell system is below a predetermined value, and the electric power supply from a fuel cell can be stopped. When system efficiency is low, an

electric power supply is performed from a rechargeable battery, and it can avoid making useless a generation of electrical energy of a fuel cell, even if it carries out like this.
[0009] The fuel cell system of this invention which has the above-mentioned configuration can also take the following modes. That is, it shall have a means to suspend operation of the fuel cell auxiliary machinery which participates said means for stopping in said generating mode. If it carries out like this, since it can avoid also using the energy which operation of these fuel cell auxiliary machinery takes, system efficiency can be improved more.
[0010] Moreover, it shall have a means to detect the remaining capacity of said rechargeable battery for said electric power supply means, and a means to forbid actuation of said means for stopping when said detection load in the case of said low loading field can be provided with said detection remaining capacity.
[0011] If it carries out like this, it is a low loading field, and moreover, in the time when the remaining capacity of a rechargeable battery is low, the generating mode of a fuel cell can be caused, a load can be satisfied, and fault of a load halt will not be caused.
[0012] Moreover, the fuel cell and rechargeable battery which the electric vehicle of this invention is an electric vehicle which obtains driving force by rotating a motor and telling the turning effort of this motor to an axle with electrical energy, and were connected to juxtaposition, The fuel cell system which has the electric power supply means which supplies power from said both cells to said load to a load is carried. Said electric power supply means of said fuel cell system A detection means to detect the magnitude of the load connected, and when a detection load is a predetermined low loading field Having the means for stopping which suspends the generating mode of said fuel cell and stops the electric power supply from said fuel cell, said motor makes it the summary to receive supply of power from said fuel cell system.
[0013] In the electric vehicle of this invention which has the above-mentioned configuration, power is supplied to a motor from a rechargeable battery, without carrying out the generating mode of the fuel cell, when the turning effort of the motor for which a car drive is asked is a small predetermined field (low loading field). For this reason, in a low loading field, since the generating mode of a fuel cell is not required, system efficiency can be improved as an electric vehicle so that a generation of electrical energy of a fuel cell may not become useless.
[0014] And in this electric vehicle, if it ** to the generating mode of a fuel cell and is made to suspend operation of fuel cell auxiliary machinery, since it can avoid also using the energy which operation of these fuel cell auxiliary machinery takes, system efficiency can be improved more.
[0015] Moreover, it is a low loading field, and when the detection load at that time (motor turning effort searched for) cannot be provided with the remaining capacity of a rechargeable battery, the generating mode of a fuel cell can be performed. If it carries out like this, since it will supply the power obtained by the generating mode of a fuel cell to a motor and this will be rotated, the situation of a motor halt is not caused and car behavior by motor halt is not caused. Therefore, it can avoid giving the sense of incongruity accompanying the car behavior by motor halt to the operator who performs actuation for rotating a motor and making a car drive.
[0016] Furthermore, like the case where the load connected is a low loading field, the generating mode of a fuel cell is suspended as the system efficiency of a fuel cell system is below a predetermined value, and the electric power supply from a fuel cell can be stopped. Even if it carries out like this, on the occasion of car transit when system efficiency is low, it runs by performing an electric power supply from a rechargeable battery, and can avoid making useless a generation of electrical energy of a fuel cell.
[0017]
[Embodiment of the Invention] In order to clarify further a configuration and an operation of this invention explained above, the gestalt of operation of this invention is explained based on an example below. Drawing 1 is a block diagram showing the outline of the configuration of an electric vehicle in which the fuel cell system 10 which is one suitable example of this invention was carried. The fuel cell system 10 of this example is carried in a car, and works as a power source for a car drive. The fuel cell system 10 uses a fuel cell 20, a rechargeable battery 30, the motor 32 for a car drive, auxiliary machinery 34, DC to DC converter 36, the remaining capacity monitor 46, a control section 50, an inverter 80, and a current sensor 90 as the main components. Hereafter, each component of the fuel cell system 10 is explained.
[0018] A fuel cell 20 is a fuel cell of a solid-state polyelectrolyte mold, and has the stack structure which carried out two or more laminatings of the single cel 28 which is a configuration unit. A fuel cell 20 receives supply of the fuel gas containing hydrogen in a cathode side, and acquires electromotive force to an anode plate side according to the electrochemical reaction shown below in response to supply of the oxidation gas containing oxygen.

[0019]
$H_2 \rightarrow 2H^+ + 2e^-$ -- (1)
$(1/2) O_2 + 2H^+ + 2e^- \rightarrow H_2O$ -- (2)
$H_2 + (1/2) O_2 \rightarrow H_2O$ -- (3)

[0020] (1) A formula shows the reaction by the side of cathode, and the reaction by the side of an anode plate of (2) types, and (3) types express the reaction which occurs by the whole cell. Drawing 2 is a sectional view which illustrates the configuration of the single cel 28 which constitutes this fuel cell 20. The single cel 28 consists of an electrolyte membrane 21, an anode 22 and a cathode 23, and separators 24 and 25.

[0021] An anode 22 and a cathode 23 are gas diffusion electrodes which constitute sandwich structure on both sides of an electrolyte membrane 21 from both sides. Separators 24 and 25 form the passage of fuel gas and oxidation gas between an anode 22 and a cathode 23, sandwiching this sandwich structure from both sides further. Fuel gas passage 24P are formed between the anode 22 and the separator 24, and oxidation gas-passageway 25P are formed between the cathode 23 and the separator 25. Although separators 24 and 25 form passage only in one side in drawing 2 , respectively, the rib is formed in the both sides in fact, one side forms fuel gas passage 24P between anodes 22, and other sides form oxidation gas-passageway 25P between the cathodes 23 with which the adjoining single cel is equipped. Thus, separators 24 and 25 have played the role which separates the flow of fuel gas and oxidation gas between the adjoining single cels while forming a gas passageway between gas diffusion electrodes. In case the laminating of the single cel 28 is carried out and stack structure is formed from the first, the separator of two sheets located in the both ends of stack structure is good also as forming a rib only in one side which touches a gas diffusion electrode.

[0022] Here, an electrolyte membrane 21 is the ion exchange membrane of proton conductivity formed by solid-state polymeric materials, for example, fluororesin, and shows good electrical conductivity according to a damp or wet condition. The Nafion film (Du Pont make) was used in this example. The alloy which consists of the platinum as a catalyst or platinum, and other metals is applied to the front face of an electrolyte membrane 21. Produce the carbon powder which supported the alloy which consists of platinum or platinum, and other metals as an approach of applying a catalyst, and the suitable organic solvent was made to distribute the carbon powder which supported this catalyst, optimum dose addition was carried out, the electrolytic solution (for example, Aldrich Chemical, Nafion Solution) was pasted, and the approach of screen-stenciling on an electrolyte membrane 21 was taken. Or the configuration which carries out film shaping of the paste containing the carbon powder which supported the above-mentioned catalyst, produces a sheet, and presses this sheet on an electrolyte membrane 21 is also suitable. Moreover, the catalyst of platinum etc. is good also as applying not the electrolyte membrane 21 but the electrolyte membrane 21 to an anode [touching] 22 and cathode 23 side.

[0023] Both the anode 22 and the cathode 23 are formed of the carbon cross woven with the yarn which consists of a carbon fiber. In addition, in this example, although the anode 22 and the cathode 23 were formed by the carbon cross, the configuration formed by the carbon paper which consists of a carbon fiber, or carbon felt is also suitable.

[0024] Separators 24 and 25 are formed by the conductive gas non-penetrated member, for example, the substantia-compacta carbon which compressed carbon and it presupposed gas un-penetrating. Separators 24 and 25 form in the both sides two or more ribs arranged in parallel, and as mentioned already, fuel gas passage 24P are formed on the front face of an anode 22, and they form oxidation gas-passageway 25P on the front face of the cathode 23 of the adjoining single cel. Here, the rib formed in the front face of each separator is good also as making a predetermined include angle -- it is not necessary to form both sides in parallel, and they go direct for every field. Moreover, it does not need to be an parallel groove, and if supply of fuel gas or oxidation gas is possible for the configuration of a rib to a gas diffusion electrode, it is good.

[0025] In the above, the configuration of the single cel 28 which is the basic structure of a fuel cell 20 was explained. When actually assembling as a fuel cell 20, stack structure is constituted by carrying out two or more set laminating of the single cel 28 constituted in order of a separator 24, an anode 22, an electrolyte membrane 21, a cathode 23, and a separator 25 (this example 100 sets), and arranging the collecting electrode plates 26 and 27 formed in the both ends by substantia-compacta carbon, a copper plate, etc.

[0026] Although not illustrated with the block diagram of drawing 1 , in order to actually generate electricity using a fuel cell, a predetermined peripheral device (fuel cell auxiliary machinery) is needed besides the body of a fuel cell which has the above-mentioned stack structure. Drawing 3 is a block diagram which illustrates the configuration of the fuel cell section 60 which consists of a fuel cell 20 and its peripheral device. The fuel cell section 60 uses the above-mentioned fuel cell 20, the methanol tank 61 and a water tank 62, the reforming machine 64, and an air compressor 66 as the main components, and also has the

pumps 61a and 62a for carrying out outflow supply of a methanol and the water from a tank.
[0027] The reforming machine 64 receives supply of a methanol and water from the methanol tank 61 and a water tank 62. reforming according [using the supplied methanol as a original fuel with the reforming vessel 64] to a steam reforming process -- carrying out -- hydrogen -- rich fuel gas is generated. The reforming reaction performed to below with the reforming vessel 64 is shown.
[0028]
$CH_3OH \rightarrow CO+2H_2$ -- (4)
$CO+H_2O \rightarrow CO_2+H_2$ -- (5)
$CH_3OH+H_2O \rightarrow CO_2+3H_2$ -- (6)
[0029] The conversion reaction of the carbon monoxide expressed with the decomposition reaction of the methanol by which the reforming reaction of a methanol performed with the reforming vessel 64 is expressed with (4) types, and (5) types advances to coincidence, and the reaction of (6) types occurs as a whole. Such a reforming reaction is endothermic reaction as a whole. the hydrogen generated with the reforming vessel 64 -- rich fuel gas is supplied to a fuel cell 20 through the fuel-supply way 68, within a fuel cell 20, in each ** cel 28, it is led to said fuel gas passage 24P, and the cell reaction in an anode 22 is presented with it. Although it is expressed with described (1) type, in order to compensate water required of this reaction and to prevent desiccation of an electrolyte membrane 21, after the reaction performed with an anode 22 forms a humidifier in the fuel-supply way 68 and humidifies fuel gas, it is good also as supplying a fuel cell 20. In addition, it is contained in the peripheral device which also described this humidifier above when a humidifier is formed in this way.
[0030] Moreover, an air compressor 66 carries out pressurization supply of the air incorporated from the outside at a fuel cell 20. The air incorporated and pressurized by the air compressor 66 is supplied to a fuel cell 20 through the air supply way 69, within a fuel cell 20, in each ** cel 28, it is led to said oxidation gas-passageway 25P, and the cell reaction in a cathode 23 is presented with it. Generally, with a fuel cell, since a reaction rate rises so that the pressure of the gas supplied to two poles increases, the cell engine performance improves. Then, the air supplied to a cathode 23 is pressurizing with the air compressor 66 in this way. In addition, the pressure of the fuel gas supplied to an anode 22 can be easily adjusted by controlling the switching condition of the electro-magnetic valve 67 of a mass flow controller prepared in the described fuel-supply way 68.
[0031] Fuel exhaust gas after being used for the cell reaction with the anode 22 in a fuel cell 20, and a part of air compressed by the air compressor 66 are supplied to the reforming machine 64. As mentioned already, the reforming reaction in the reforming machine 64 is endothermic reaction, and since supply of heat is required, heating is equipped with the burner which is not illustrated in the reforming machine 64 interior from the exterior. The above-mentioned fuel gas and a compressed air are used for combustion of this burner. The fuel exhaust gas discharged from the anode plate side of a fuel cell 20 is led to the reforming machine 64 by the fuel exhaust passage 71, and the compressed air is led to the reforming machine 64 by the branching air conduit 70 which branches from the air supply way 69. The hydrogen which remains in fuel exhaust gas, and the oxygen in a compressed air are used for combustion of a burner, and supply a heating value required for a reforming reaction.
[0032] Such a fuel cell 20 can control an output by adjusting the amount of fuel gas, and oxidation capacity according to the magnitude of the load connected. Control of this output is performed by the control section 50. That is, the driving signal from a control section 50 is outputted to the electro-magnetic valve 67 prepared in the air compressor 66 mentioned already or the fuel-supply way 68, the amount of distributed gas is controlled by adjusting the amount of drives and switching condition, and the output of a fuel cell 20 is adjusted.
[0033] The fuel cell 20 explained above is connected to a rechargeable battery 30, a motor 32, and auxiliary machinery 34 as shown in drawing 1 . This fuel cell 20 charges a rechargeable battery 30 according to the condition of these loads while supplying power to a motor 32 and auxiliary machinery 34. In this case, the fuel cell 20 is connected to a motor 32 and auxiliary machinery 34 through switch 20a, and the electric power supply of a motor 32 or auxiliary machinery 34 and charge of a rechargeable battery 30 are performed through closing motion control of this switch 20a by the control section 50, or switch 30a by the side of a rechargeable battery.
[0034] It returns to drawing 1 and the configuration of each part is explained further. A rechargeable battery 30 is a power unit which supplies power to a motor 32 and auxiliary machinery 34 with the above-mentioned fuel cell 20. Although the lead accumulator was used in this example, rechargeable batteries of other type, such as a nickel cadmium battery, a nickel-hydrogen battery, and a lithium rechargeable battery,

can also be used. The capacity of this rechargeable battery 30 is determined by the engine performance (full speed, mileage, etc.) of the transit conditions the magnitude of the car carrying the fuel cell system 10 and this car are assumed to be, or the car demanded etc.

[0035] A motor 32 is a three phase synchronous motor. The direct current which a fuel cell 20 and a rechargeable battery 30 output is changed into the three-phase alternating current by the inverter 80 mentioned later, and is supplied to a motor 32 by it. In response to supply of such power, a motor 32 generates rotation driving force, and through the axle in the car carrying the fuel cell system 10, this rotation driving force is told to the front wheel and/or rear wheel of a car, and turns into power which makes it run a car. This motor 32 receives control of a control unit 33. The control device 33 is connected with accelerator pedal position sensor 33b which detects the control input of accelerator pedal 33a. Moreover, the control unit 33 is connected also with the control section 50, and the various information about the drive of a motor 32 etc. is exchanged between this control section 50.

[0036] Auxiliary machinery 34 is the loads which consume the power of predetermined within the limits during operation of the fuel cell 20 in the fuel cell system 10. For example, an others and mass flow controller, the Water pump which is not illustrated are equivalent to these auxiliary machinery. [pumps / 61a and 62a / the air compressor 66 mentioned already as a peripheral device and / of a methanol and water / each] An air compressor 66 adjusts the oxidation gas pressure supplied to a fuel cell 20, as mentioned already. Moreover, a Water pump controls the internal temperature of a fuel cell 20 below to predetermined temperature by pressurizing cooling water, circulating the inside of a fuel cell 20, circulating cooling water in this way, and making heat exchange perform within a fuel cell 20. A mass flow controller adjusts the pressure and flow rate of fuel gas which are supplied to a fuel cell 20 as mentioned already. Therefore, although a fuel cell 20 and auxiliary machinery 34 are expressed with the block diagram of drawing 1 independently, about the device in connection with control of the operational status of these fuel cells 20, it can also be called the peripheral device of a fuel cell 20. It increases, so that the amount of generations of electrical energy of power consumption of such auxiliary machinery 34 of a fuel cell 20 of a thing increases few compared with the power consumption of a motor 32. Moreover, these auxiliary machinery is operated irrespective of the size of the amount of generations of electrical energy under the situation that the fuel cell 20 is carrying out the generating mode. This point is explained.

[0037] Drawing 4 is an explanatory view for explaining the effectiveness as a fuel cell 20, and current density, the effectiveness of a single cel simple substance, the explanatory view showing relation with a cell (FC) output, the explanatory view in which drawing 4 (b) expresses the relation between auxiliary machinery power and FC output, and drawing 4 (c) of drawing 4 (a) are the explanatory views showing the relation between FC output and FC system efficiency. In a single cel, in case current density tends to be raised and it is going to increase the amount of generations of electrical energy, according to it, increase-in-quantity supply of the fuel gas for a generation of electrical energy (oxygen, reformed gas) is carried out. Thus, when gas supply increases, the capacity which passes a single cel will also increase without presenting the electrode reaction in the yin and yang mentioned already, and non-involved capacity will increase to a generation of electrical energy. Therefore, if current density increases as it is shown in drawing 4 (a), when single cel effectiveness is specified as the amount of generations of electrical energy per amount of distributed gas (current density), single cel effectiveness will fall. In addition, as a fuel cell 20 which is the set of a single cel, the output (FC output) becomes so large that current density becomes large as a drawing middle point line shows.

[0038] On the other hand, the above-mentioned peripheral device of air compressor 66 grade needs the power which increases mostly according to the increment in the amount of distributed gas (namely, FC output), and predetermined power is needed even if it is the case that FC output is low (refer to drawing 4 (b)). These results, the system efficiency (for example, value which did the division of the power which deducted the power which an auxiliary machinery drive takes from the amount of generations of electrical energy with gas supply volume) as a fuel cell 20 falls, so that FC output is small, as shown in drawing 4 (c).

[0039] DC to DC converter 36 changes the electrical potential difference of the electrical energy which a fuel cell 20 and a rechargeable battery 30 output, and supplies it to auxiliary machinery 34. An electrical potential difference required to drive a motor 32 is usually about 200V-300V, and the electrical potential difference corresponding to this is outputted from the fuel cell 20 and the rechargeable battery 30. However, the electrical potential difference when driving the auxiliary machinery 34, such as a Water pump mentioned already, is about 12V, and cannot supply the electrical potential difference outputted from a fuel cell 20 and a rechargeable battery 30 in the condition as it is. Therefore, the electrical potential difference is dropped with DC to DC converter 36.

[0040] By changing switch 20a by the side of the above-mentioned fuel cell, and switch 30a by the side of a rechargeable battery, a fuel cell 20 and a rechargeable battery 30, and a motor 32 can be connected, or it can separate. The connection condition of each above-mentioned switch is controlled by the control section 50.
[0041] The remaining capacity monitor 46 detects the remaining capacity of a rechargeable battery 30, and is constituted by SOC meter here. SOC meter integrates the current value and time amount of charge and discharge in a rechargeable battery 30, and a control section 50 calculates the remaining capacity of a rechargeable battery 30 based on this value. The remaining capacity monitor 46 is good also as constituting by the voltage sensor instead of SOC meter here. Since an electrical-potential-difference value falls as that remaining capacity decreases, a rechargeable battery 30 can detect the remaining capacity of a rechargeable battery 30 by measuring an electrical potential difference using this property. A control section 50 can calculate the remaining capacity of a rechargeable battery 30 based on the measured value inputted from a voltage sensor by connecting such an electrical-potential-difference sensor to a control section 50, and memorizing the relation of the electrical-potential-difference value and remaining capacity in a voltage sensor beforehand to the control section 50. Or the remaining capacity monitor 46 is good also as a configuration which measures the specific gravity of the electrolytic solution of a rechargeable battery 30, and detects remaining capacity.
[0042] A control section 50 is constituted as a logical circuit centering on a microcomputer, and consists of CPU52, ROM54, RAM56, and input/output port 58. CPU52 performs a predetermined operation etc. according to the control program set up beforehand. A control program, control data, etc. required to perform various data processing are beforehand stored in ROM54 by CPU52, and various data required to perform various data processing by CPU52 as well as RAM56 are written temporarily. While input/output port 58 inputs the detecting signal from various sensors, such as the remaining capacity monitor 46, etc., according to the result of an operation in CPU52, it outputs a driving signal to an inverter 80 etc., and controls the drive condition of each part of a fuel cell system.
[0043] In drawing 1 , although only the input of the detecting signal from the remaining capacity monitor 46 and the signal from a current sensor 90, the output of the driving signal of an inverter 80, and the exchange of the signal between control units 33 were shown about the control section 50, in addition to this, the control section 50 is performing various control in a fuel cell system. As main things, control of the operational status of a fuel cell 20 can be mentioned in the control by the control section 50 which is not illustrated. As mentioned already, a driving signal is outputted to an air compressor 66 or a mass flow controller, control oxidation capacity and the amount of fuel gas, the amount of the methanol supplied to the reforming machine 64 and water is controlled, or the control section 50 is also performing temperature management of a fuel cell 20, and temperature management of the reforming machine 64.
[0044] An inverter 80 changes into three-phase-circuit alternating current the direct current supplied from a fuel cell 20 or a rechargeable battery 30, and supplies it to a motor 32. Here, it is controllable in the driving force generated by the motor 32 by adjusting the amplitude (in fact pulse width) and frequency of a three-phase-circuit alternating current which are supplied to a motor 32 based on the directions from a control section 50. This inverter 80 is constituted considering six switching elements (for example, the bipolar form MOSFET (IGBT)) as a main circuit component, and changes into the amplitude of arbitration, and the three-phase alternating current of a frequency the direct current supplied by the switching operation of these switching elements from a fuel cell 20 and a rechargeable battery 30. Electric conduction Rhine connects with the control section 50, and each switching element with which an inverter 80 is equipped receives control of the timing of the switching with the driving signal from a control section 50.
[0045] The connection condition with this inverter 80, a fuel cell 20, or a rechargeable battery 30 is determined by control of the above-mentioned switches 20a and 30a. That is, connection of the inverter 80 besides connection between an inverter 80 and a fuel cell 20 and a rechargeable battery 30 and the concurrent connection of the fuel cell 20 to an inverter 80 and a rechargeable battery 30 are possible. And while taking these connection conditions, the output control (generation-of-electrical-energy operation control) of a fuel cell 20 can be performed to arbitration, and the output control (control of output ON and an output OFF) of a rechargeable battery 30 can also be performed to arbitration. On the other hand, since the output adjustment of a fuel cell or the rechargeable battery cannot be carried out from that configuration in JP,7-240212,A mentioned already at arbitration, in this example, it is advantageous to the system of this JP,7-240212,A.
[0046] A current sensor 90 detects the output current from a rechargeable battery 30. Although the output state of a rechargeable battery 30 has the case of discharge, and the case of charge, it is henceforth called the output current about the case of both charge and discharge. This current sensor 90 has connected with a

control section 50, and the current value detected by the current sensor 90 is inputted into a control section 50. The inputted current value is used in case the charge-and-discharge condition in a rechargeable battery 30 is judged.
[0047] Next, the fuel cell control which the fuel cell system 10 which has the above-mentioned configuration performs is explained. Drawing 5 is a flow chart showing the contents of processing of this fuel cell control. In the car carrying the fuel cell system 10, this fuel cell control is performed for every predetermined time and every 10microsec by CPU52 from from, when the predetermined start switch which starts this fuel cell system is turned on.
[0048] Activation of this routine performs reading of the drive demand power which the operator of an electric vehicle who carried this system demands through accelerator actuation first, and reading of the remaining capacity Q of a rechargeable battery 30 (step S100). This drive demand power is the power (power) for rotating a motor 32 according to a demand of an operator, and a car is provided with the generated output of a fuel cell 20, and the discharge power of a rechargeable battery 30. In this case, drive demand power reads and calculates the control input (output of accelerator pedal position sensor 33b) of accelerator pedal 33a in inputting through a control unit 33. Moreover, the remaining capacity Q of a rechargeable battery 30 is read from the output value of the remaining capacity monitor 46, and is calculated. If these reading operation is followed, the set condition of the intermittent flag fk which shows the purport which is in on-off operation mode in which a fuel cell 20 is operated intermittently is judged (step S110). If this intermittent flag fk is in a reset condition about set-reset being carried out by the below-mentioned processing, and carrying out on-off operation of the fuel cell 20 if it is in a set condition, it means carrying out continuous running of the fuel cell 20.
[0049] Here, when it judges with it being intermittent flag fk=0 (reset condition; continuous running), drive demand power judges whether it is smaller than the predetermined threshold power Xpw (step S120). As shown in drawing 4 (c), since the output of a fuel cell 20 is low, the threshold power Xpw is the value (fuel cell output) of the field where system efficiency is low, and is set by this example to about 10% of the generation-of-electrical-energy capacity (power serviceability) of a fuel cell 20. In addition, it is not necessarily restricted to what this threshold power Xpw can set up many things according to the remaining capacity Q read at the charge-and-discharge capacity and step S100 of a rechargeable battery 30, and was described above.
[0050] Although it is in the situation to which continuous running of the fuel cell 20 is carried out in response to a judgment (fk=0) at step S110 when an affirmation judging is carried out at this step S120, drive demand power will be smaller than the threshold power Xpw. Therefore, a value 1 is put into the intermittent flag fk, and this is set so that the purport which shifts the operation mode of a fuel cell 20 to on-off operation mode from continuous-running mode may be shown in this case (step S130). Next, the remaining capacity Q and drive demand power which were read at step S100 are contrasted, and it judges whether a motor 32 can be rotated with the power of the remaining capacity Q of a rechargeable battery 30 as drive demand power (step S140). That is, it judges whether drive demand power can be satisfied by remaining capacity Q.
[0051] When it judges with the ability of drive demand power to be satisfied by remaining capacity Q at this step S140, the fuel cell 20 in a low generation-of-electrical-energy field and operation of the fuel cell device group containing the above-mentioned fuel cell peripheral device of air compressor 66 grade are actually suspended (step S150). Then, the power of remaining capacity Q is supplied to a motor 32 from a rechargeable battery 30 (step S160), and this routine is once ended. Thereby, a motor 32 rotates by the electric power supply only from a rechargeable battery 30, and drives a car by drive demand power.
[0052] On the other hand, at step S150, by remaining capacity Q, when it judges with the ability of drive demand power not to be satisfied, while carrying out the generating mode of the above-mentioned fuel cell device group, a value 0 "zero" is put into the intermittent flag fk, and this is reset that a rechargeable battery 30 and a fuel cell 20 should be used together, so that the purport which shifts to the continuous-running mode of a fuel cell 20 may be shown (step S170). Thereby, a car drive by drive demand power is attained at the rotation list of a motor 32 with the power of the remaining capacity Q of a rechargeable battery 30, and the power which the fuel cell 20 generated.
[0053] If this step S170 is followed, power is supplied to a motor 32 from a rechargeable battery 30 and a fuel cell 20 (step S180), and this routine is once ended so that drive demand power can provide meals with the power of the remaining capacity Q of a rechargeable battery 30, and the power which generated the fuel cell 20. If it explains in more detail, the power which should generate them with a fuel cell 20 from these both by reading by step S100 since drive demand power and remaining capacity Q are known will become

settled. Therefore, the fuel gas amount of supply mentioned already for generating this fixed power is calculated, the above-mentioned peripheral device is operated according to that result, and the power which became settled the account of a top is generated with a fuel cell 20. Thereby, a motor 32 rotates by the electric power supply from a rechargeable battery 30 and a fuel cell 20, and drives a car by drive demand power.

[0054] Moreover, when it judges with drive demand power being more than the threshold power Xpw at step S120, it can be said that what is necessary is just to carry out a generating mode for a fuel cell 20 in the situation that system efficiency is high, for obtaining drive demand power. Therefore, it shifts to step S170 in order to provide drive demand power with the power of a rechargeable battery 30, and the generated output of a fuel cell 20. Thereby, a motor 32 rotates by the electric power supply from a rechargeable battery 30 and a fuel cell 20, and drives a car by drive demand power.

[0055] On the other hand, when it judges with it being intermittent flag fk=1 (set condition; on-off operation) at step S110 mentioned already, it judges whether drive demand power is larger than threshold power Xpw+alpha (step S190). Although it is in the situation to which on-off operation of the fuel cell 20 is carried out in response to a judgment (fk=1) at step S110 here when an affirmation judging is carried out, drive demand power will be larger than threshold power Xpw+alpha. Therefore, it shifts to step S170 in order to provide this big drive demand power with the power of a rechargeable battery 30, and the generated output of a fuel cell 20. Thereby, a motor 32 rotates by the electric power supply from a rechargeable battery 30 and a fuel cell 20, and drives a car by drive demand power.

[0056] Moreover, when a negative judging is carried out at step S190, drive demand power is still small. Therefore, it shifts to step S140 and processing after it mentioned already is performed in order to provide this drive demand power with the remaining capacity Q of a rechargeable battery 30, with the fuel cell device group containing a fuel cell 20 and its peripheral device stopped. Thereby, the fuel cell system 10 rotates a motor 32 by the remaining capacity Q of (step S150) and a rechargeable battery 30 under the halt situation of a fuel cell device group (step S160), and drives a car by drive demand power. Moreover, in remaining capacity Q, when insufficient, a motor 32 is rotated by the electric power supply from (a step S140; negation judging), a rechargeable battery 30, and a fuel cell 20 (step S 170 180), and a car is driven by drive demand power.

[0057] As explained above, the fuel cell system 10 of this example defines operation and a halt of the fuel cell device group containing a fuel cell 20 and its peripheral device with the magnitude of the drive demand power of the car which an operator demands through treading-in actuation of accelerator pedal 33a. That is, when this drive demand power is what is obtained by the generating mode of a heavy load field for a fuel cell 20, (a step S120; negation judging) and a fuel cell device group are operated, a generation of electrical energy is rotated with a fuel cell 20, a motor 32 is rotated with a lifting (step S170), this power, and the power of a rechargeable battery 30, and a car is driven (step S180). Therefore, in this case, the generating mode of the fuel cell 20 can be efficiently carried out in a heavy load field, and system efficiency can be improved as the fuel cell system 10, as a result an electric vehicle in which this was carried.

[0058] When drive demand power is what is obtained by the generating mode of a low loading field for a fuel cell 20, on the other hand, (A step S120; affirmation judging), If motor rotation can be provided with the remaining capacity Q of a rechargeable battery 30 (step S140; affirmation judging) The fuel cell device group containing a fuel cell 20 and its peripheral device is stopped (step S150), a motor 32 is rotated by the remaining capacity Q by rechargeable battery 30 independent one (step S160), and a car is driven by drive demand power. Therefore, since it can avoid carrying out the generating mode of the fuel cell 20 in a low loading field, system efficiency can be improved as an electric vehicle in which causing a useless generation of electrical energy of a fuel cell 20 was lost, and the fuel cell system 10, as a result this were carried. And since it combines with the shutdown of a fuel cell 20 and operation of the peripheral device of air compressor 66 grade is also suspended, as the energy which operation of these equipments takes is not used, either, system efficiency can be improved more.

[0059] Moreover, even if drive demand power is the thing of a low loading field, when motor rotation runs short of the remaining capacity Q of a rechargeable battery 30, (a step S140; negation judging) and a fuel cell device group are made to operate, a motor 32 is rotated with the power of a rechargeable battery 30 and a fuel cell 20 (step S 170 180), and a car is driven by drive demand power. For this reason, since a car can be driven in the state of the drive which an operator means, sense of incongruity is not given to an operator.

[0060] Moreover, in this example, since drive demand power increased, when operating a fuel cell 20 from the situation of having stopped the fuel cell 20 since drive demand power was below the threshold power Xpw, it was presupposed that the fuel cell 20 has been stopped until this drive demand power became larger

than threshold power Xpw+alpha (step S190). Therefore, even if drive demand power fluctuates around the threshold power Xpw, hunting which repeats operation and a halt of a fuel cell 20 is avoidable. For this reason, allophone generating of the pump which is the fault by hunting, for example, the peripheral device of a fuel cell 20, etc. is avoidable.
[0061] Although the example of this invention was explained above, as for this invention, it is needless to say that it can carry out in the mode which becomes various in the range which is not limited to an above-mentioned example or an above-mentioned operation gestalt at all, and does not deviate from the summary of this invention.
[0062] For example, in enabling it to perform the output control (generation-of-electrical-energy operation control) of a fuel cell 20, and the output control of a rechargeable battery 30 to arbitration, it can also be performed as follows. Drawing 6 is a block diagram for explaining the configuration of the important section of a modification. In the modification shown in this drawing 6 , DC to DC converter 30b was made to intervene, and the rechargeable battery 30 was connected to the fuel cell 20 at juxtaposition. When carrying out like this, after carrying out output adjustment of a rechargeable battery 30 by DC to DC converter 30b, the output (power) concerned can be supplied to a motor 32.
[0063] Moreover, although the above-mentioned example explained the case where the number of the fuel cell stacks containing a fuel cell 20 and auxiliary machinery 34 was one, it is applicable also about the system which has two or more fuel cell stacks. In this case, if shutdown including a fuel cell generation-of-electrical-energy halt or supplements can be performed and is carried out like this based on the magnitude of a load for every fuel cell stack, the generation of electrical energy by each fuel cell stack will not be made useless.

[Translation done.]

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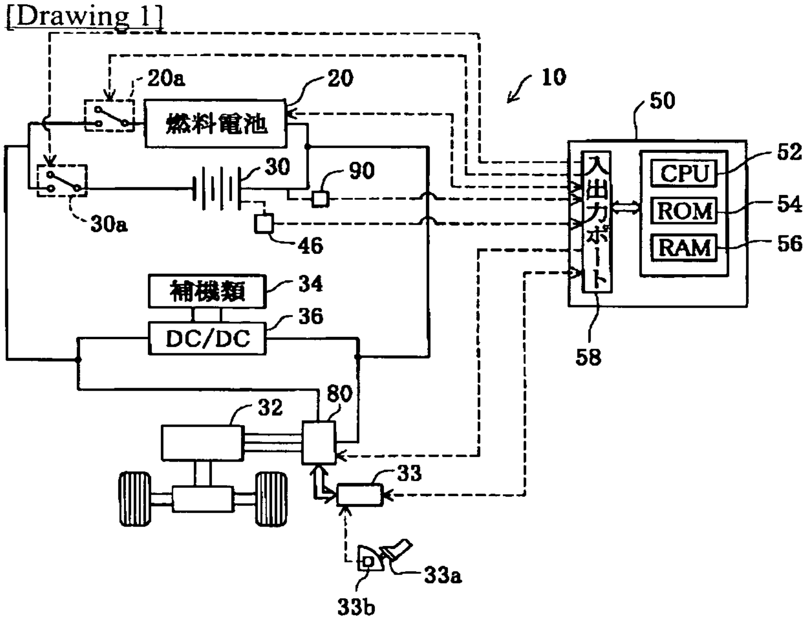
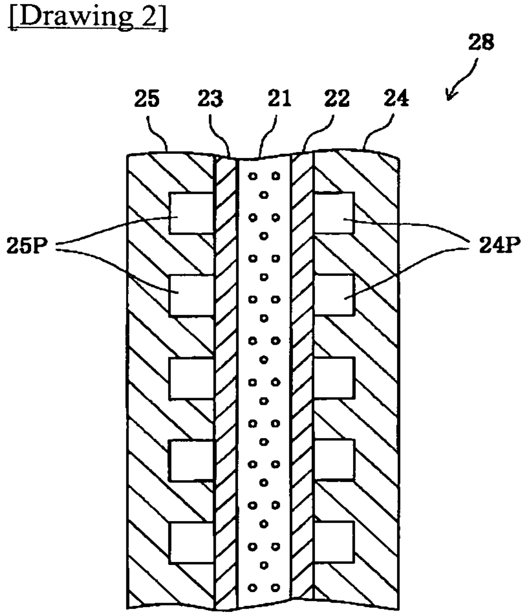
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

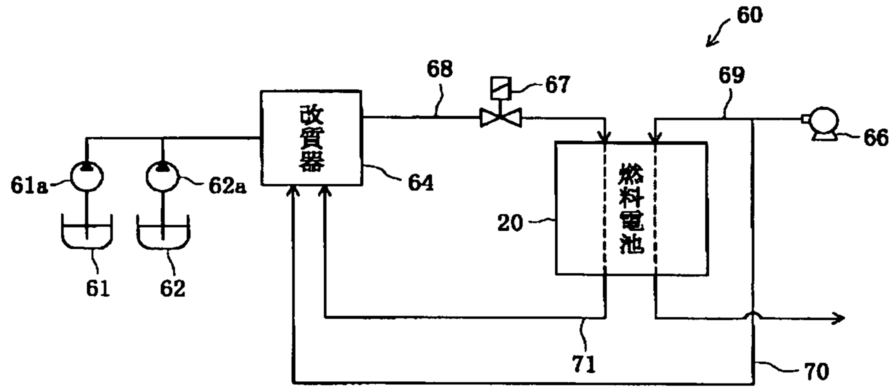
[Drawing 1]



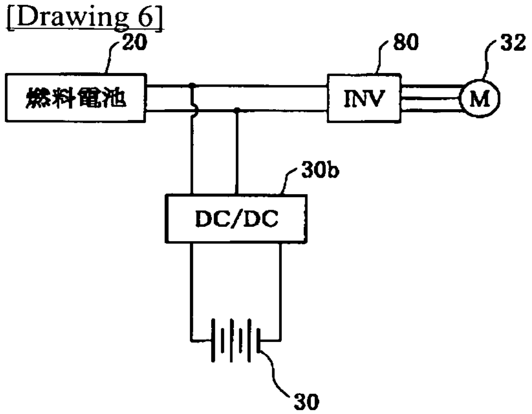
[Drawing 2]



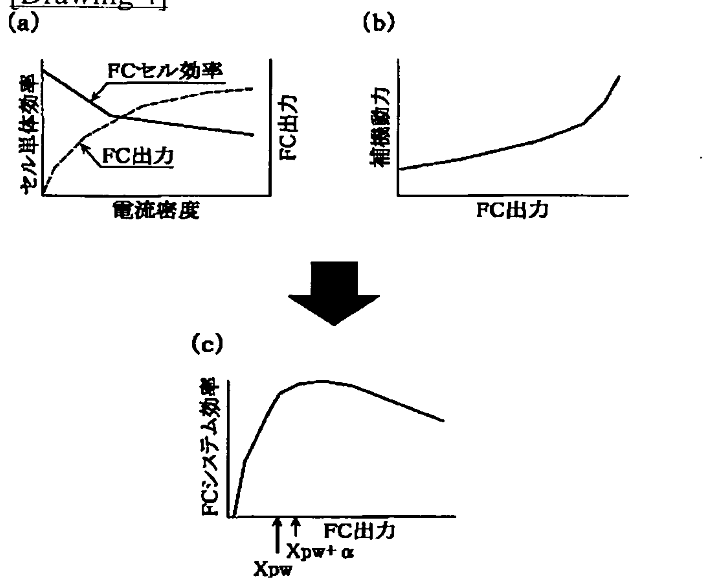
[Drawing 3]



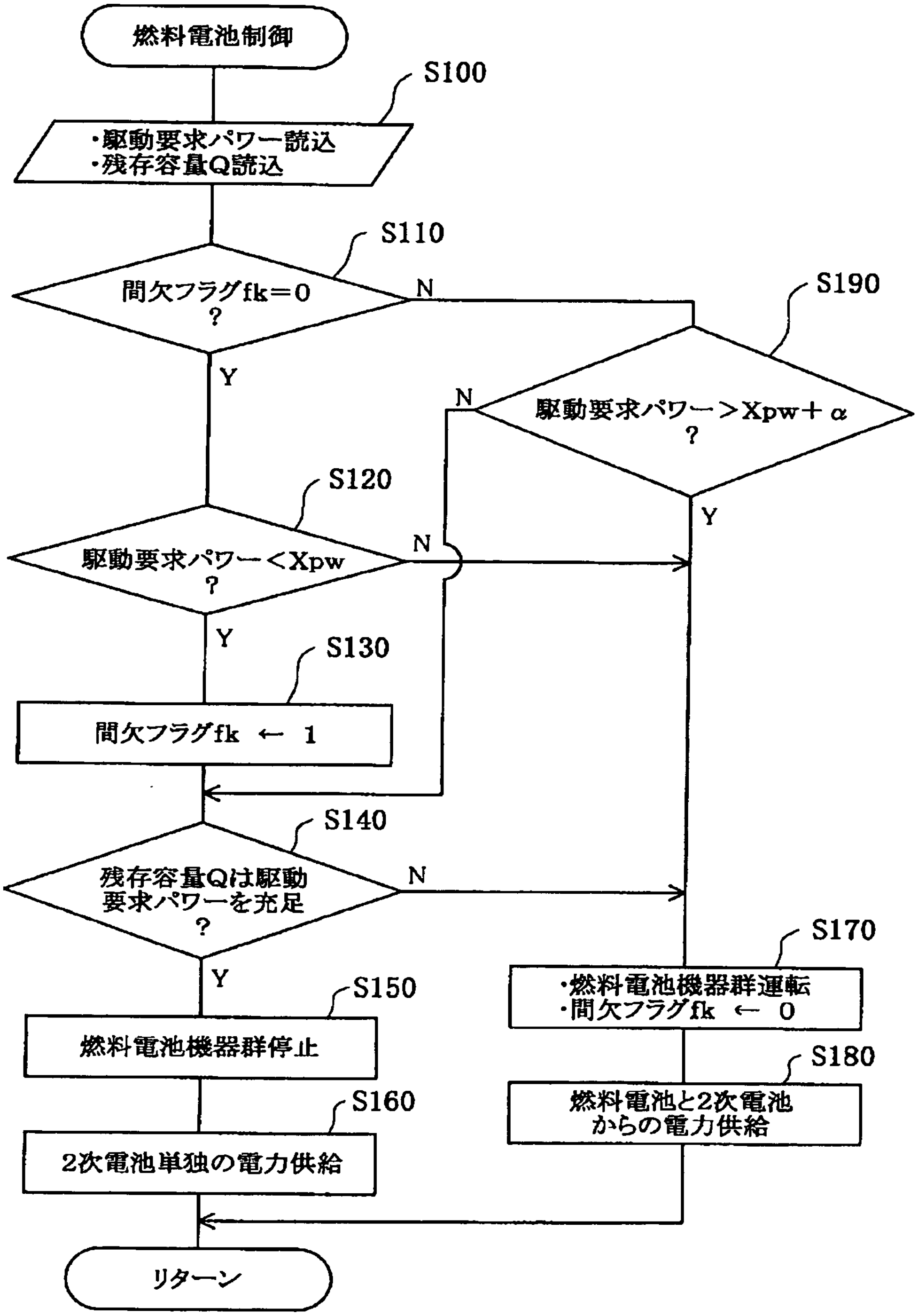
[Drawing 6]



[Drawing 4]



[Drawing 5]



[Translation done.]